UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL
CLEANUP

February 9, 2017

MEMORANDUM

SUBJECT: Request to Conduct a Supplemental Engineering Evaluation/Cost Analysis (EE/CA) for the Non-Time-Critical Removal Action at Earle M. Jorgensen Early Action Area, Lower Duwamish Waterway Superfund Site, King County, Washington

FROM: Rebecca Chu, Remedial Project Manager Rebecca Chu

THRU: Davis Zhen, Unit Manager
Site Cleanup Unit 2, Office of Environmental Cleanup

TO: Beth Sheldrake, Acting Program Manager
Remedial Cleanup Program, Office of Environmental Cleanup

I. PURPOSE

The purpose of this Memorandum is to request and document approval to conduct a supplemental EE/CA for the non-time-critical removal action (NTCRA) at the Earle M. Jorgensen (EMJ) Early Action Area (EEA) of the Lower Duwamish Waterway (LDW) Superfund Site. The Superfund ID No. is WAN0002329803 and the Site ID No. for the EAA is 10DT.

The proposed supplemental EE/CA is anticipated to be a potentially responsible party (PRP) lead action with EPA oversight, to be conducted under an amendment to a November 5, 2012, Settlement Agreement between EPA and EMJ. The Settlement Agreement requires that EMJ conduct a NTCRA in accordance with EPA's (2011) Action Memorandum. The Action Memorandum requires full removal of all contaminated sediment and bank material above the Removal Action Level (RvAL) for PCBs of 12 mg/kg Organic Carbon (OC) normalized, or 130 μg/kg dry weight. While some work was performed at the EAA during the summer of 2014, a recent analysis of the existing EAA conditions finds ongoing risks to human health and the environment exist at the EAA due to PCBs in sediments above the RvAL in surface and subsurface sediments.

The proposed supplemental EE/CA will evaluate alternatives for cleanup of the areas where ongoing risks to human health and the environment exist due to PCBs remaining onsite in the surface and subsurface sediments after the 2014 work. Pending approval of this Memorandum, EPA anticipates amending the 2012 Settlement Agreement to include the preparation of the supplemental EE/CA by EMJ. The supplemental EE/CA document and other actions related to the potential alteration of the NTCRA will be prepared and conducted, in accordance with applicable laws, regulations, and EPA policy and guidance.

This action meets the criteria for initiating a removal action under the National Contingency Plan (NCP), 40 CFR § 300.415. The process and rationale for proceeding with a NTCRA are described below.

II. BACKGROUND

The information that follows details the proposed supplemental EE/CA.

A. Site Location

The EMJ sediment site is an EAA within the LDW Superfund Site. It is located immediately south of the Boeing Plant 2 facility, and across from the T-117 Early Action Area. The street address for the upland facility (Jorgensen Forge) is 8531 East Marginal Way South in Seattle, Washington. The sediments at the EAA cover approximately 1.6 acres and consist primarily of intertidal and subtidal sediment.

B. Site Description & Ownership

The following description of the EAA, along with an overview of its ownership, is based on the original 2011 EE/CA developed for the EMJ NTCRA by Anchor Environmental QEA on behalf of EMJ, along with subsequent information of ongoing work at the EAA.

The development of the Jorgensen Forge upland facility was financed by the U.S. Navy in 1942 for the production of naval equipment (e.g. propeller shafts). Facility operations included forging, heat-treating, and machining. At some point between May 1944 and July 1945, a small embayment on the western portion of the facility was filled, although the source of the fill material is unknown (see dashed line along the shoreline on Figure 1).

Ownership of the upland facility has changed throughout the years. In 1945, Isaacson Iron Works purchased the property and equipment from the U.S. Navy and continued to operate as a fabricator of structural steel, tractors and road equipment until 1965. Bethlehem Steel operated a steel distribution center on the northwestern portion of the facility from approximately 1951 to 1963. This work involved cutting prefabricated steel rods. Following the closure of the distribution center, the aboveground structures associated with the distribution center were removed. From 1965 to 1992, the facility was owned and operated by EMJ and continued to operate in a similar fashion. From 1992 until more recently, the facility was owned and operated by Jorgensen Forge Corporation. In 2016, Jorgensen Forge Corporation declared bankruptcy.

The current Jorgensen Forge facility occupies approximately 20 acres at 8531 East Marginal Way South in Seattle, Washington, and is located in the uplands directly east of the EAA. The facility contains an approximately 124,000-square-foot building of prefabricated steel that houses a Machine Shop Area, Forge Shop Area, Hollowbore Area, Melt Shop Area, Heat Treat Area, and Shipping Area (Figure 1). The facility also contains a building that houses an Aluminum Heat Treating Area and several smaller buildings used for offices, a metallurgical laboratory, and storage areas. Currently the facility is changing ownership. Therefore, at this time, the future land and water use is undetermined.

C. Prior Response Actions

On November 5, 2012, EPA and EMJ entered into a Settlement Agreement which requires that EMJ implement EPA's 2011 Action Memorandum (AM) for the EMJ NTCRA. EPA's AM requires removal of all sediment and bank materials above the RvAL established for the EAA. The contaminants of concern for the EAA are metals (cadmium, lead, chromium, copper, mercury, silver, zinc and arsenic) co-located with PCBs. The RvALs, established in the AM and based on Washington State's Model Toxics Control Act Sediment Quality Standards (MTCA SQS) for the protection of benthic marine invertebrates, are as follows:

Constituent	RvAL mg/kg (ppm)
PCBs (total)	12 OC normalized
Cadmium	5.1
Lead	450
Chromium	260
Copper	390
Mercury	0.41
Silver	6.1
Zinc	410
Arsenic	51

The MTCA SQS value represents the level at which no adverse effects are expected to the benthic invertebrates based on benthic toxicity.

Because the metals are co-located with PCBs, the PCB RvAL of 12 mg/kg OC is applied as the surrogate value to all of the contaminants of concern for the purposes of the removal action design/removal action work plan.

Note that the MTCA SQS value for PCBs is reported as Organic Carbon normalized, or "OC normalized". When organic carbon falls outside the recommended range for organic carbon normalization, the data are reported in "µg/kg dry weight". The dry weight equivalent for the PCB SQS of 12 mg/kg OC normalized is 130 µg/kg dry weight. Therefore, this document will make references to PCB data which are OC normalized where possible; and report data in dry weight equivalent where organic carbon falls outside the recommended range for OC normalization.

The AM required the following work:

- Removal of contaminated sediments and soil with disposal at an off-site commercial disposal facility, followed by backfilling with clean material, including:
  - Dredge approximately 21,000 cubic yards of contaminated sediment, bank soil and other debris;
  - Prior to backfill, collect confirmation samples to document the nature of dredge surface & continue to dredge until RvALs are reached;
  - Place clean backfill in the EAA to original site contours, as appropriate; and
  - Disposal of dredging material in an off-site landfill that meets all state and federal requirements for disposal of such material.
- Perform baseline and long term groundwater monitoring to demonstrate that the bank action removed the contaminants from the EAA;
- Stormwater must be monitored to ensure that recontamination of sediments does not occur or result in harmful exposure to benthic organisms;
- Fish consumption Institutional Controls (ICs) are in place (re-evaluated in the LDW-wide remedial decision making process); and
- Long-term monitoring and reporting to establish initial efficacy and assess for recontamination at the site.

EMJ conducted some dredging and excavation removal work in July through September 2014. This included excavation of bank material within the EAA and replacing it with materials amended with carbon and rip rap; dredging of contaminated sediment within a cofferdam at the north/east boundary of the EAA and replacing it with backfill material; and dredging the remaining sediments across the EAA and replacing most of it with backfill material. Data suggest no backfill was placed along the western edge of the EAA, which abuts the navigation channel. Therefore, two data sets apply to the current “surface conditions” of the area where no backfill was placed: (1) the “z-layer” data subsurface sediment samples, which document the leave surface post dredge, reflects the current “surface conditions” where no backfill material was placed along the navigation channel; and (2) the surface sediment samples collected at the site after some work was completed in the summer of 2014. A description of both of these data set follows.

i. Z-layer subsurface sediment samples

Analysis of seven samples of the 0-1 foot interval below the dredge depth collected during the summer of 2014 detected PCBs 2 to 105 times greater than the RvAL of 12 mg/kg (or 130 µg/kg dry weight) (Figure 2). The seven sample locations represent the leave surface across the five in-water “Dredge Management Units” (DMU) of the EAA. Because the samples are used to reflect the entire leave surface of a given DMU; these samples reflect the surface conditions in those areas (primarily abutting the navigation channel) where no backfill material was placed.

Sample Location	**PCB Concentration**
PDS-1	167.7 mg/kg OC
PDS-2	36.3 mg/kg OC
PDS-3	145.7 mg/kg OC
PDS-4	46.3 mg/kg OC
PDS-5	39.2 mg/kg OC
PDS-6	23.5 mg/kg OC
PDS-7	13600 µg/kg dry weight

Contrary to the requirements of the Settlement Agreement and AM, backfill was placed at portions of the EAA prior to the final analysis of these samples although complete removal of all material above the removal action levels was not achieved.

In early 2016, EMJ re-sampled these locations, below the backfill at the dredge surface, for the following intervals: 0 to -1 foot; - 1 to -2 foot; and -2 to -3 foot. These samples found PCBs concentrations above the RvAL (130 µg/kg dry weight) at four of sample locations (underlined below).

Sample Location	**PCB Concentration 0-1 ft.**	**PCB Concentration 1-2 ft.**	**PCB Concentration 2-3 ft.**
PDS-1	<u>199 µg/kg dry weight</u>	13.9 µg/kg dry weight	3.9 µg/kg dry weight
PDS-2	14.4 µg/kg dry weight	2.8 µg/kg dry weight	N/A
PDS-3	22.6 µg/kg dry weight	2.9 µg/kg dry weight	N/A
PDS-4	3.9 µg/kg dry weight	3.9 µg/kg dry weight	N/A
PDS-5	<u>2,830 µg/kg dry weight</u>	<u>176 µg/kg dry weight</u>	4 µg/kg dry weight
PDS-6	54.2 µg/kg dry weight	3.9 µg/kg dry weight	N/A
PDS-7	<u>2,200 µg/kg dry weight</u>	110.6 µg/kg dry weight	34.8 µg/kg dry weight

Because of the heterogeneity of PCB concentrations across the EAA, as well as any deviation or off-set at a given sample location between the sampling events, it is not appropriate to supplant the 2014 z-layer data with the 2016 z-layer data. Instead, both sets of data have been considered in evaluating any ongoing risks posed by the EAA. More discussion regarding ongoing risks posed by the EAA can be found in Section III “Nature and Extent of Contamination.”

ii. Surface sediment samples

The Settlement Agreement required that EMJ collect surface sediment samples after placing the backfill material as part of the long-term sampling efforts at the site. However, EMJ did not collect those samples upon completing some work in the summer of 2014. Despite this omission, surface sediment samples have been collected by various parties (The Boeing Company, EMJ) between 2014 through 2016. These sampling events of the surface sediments (0-2 cm; 0-10 cm) have also found PCB concentrations above the PCB RvAL across the surface EAA after some removal work was completed in 2014. EMJ sampling locations can be found in Figure 3.

Total PCB Concentration mg/kg OC Unless Otherwise Noted (Highlighted are above RvAL)					
Sample Location	**0-2 cm (10/2015)**	**0-2 cm (1/2016)**	**0-10 cm (10/2015)**	**0-10 cm (1/2016)**	**0-60 cm (2016) µg/kg**
LTR-1	9.4	3.4	30.9	14.2	N/A
LTR-2	11.2	4.0	11.5	8.3	6.3
LTR-3	10.3	4.4	15.1	8.0	19.9
LTR-4	22 µg/kg	5.7	35 µg/kg	10.8 µg/kg	N/A
LTR-5	40.6 µg/kg	3.5	30.6 µg/kg	6.8	42
LTR-6	11.5	13.5	53 µg/kg	13.6	38.4
LTR-7	26.1 µg/kg	2.9	6.7 µg/kg	10.6 µg/kg	3.0 mg/kg
LTR-8	8.0	9.0	6.9	17.7	6.6
LTR-9	13.2	3.1	24.2	3.5	34.4
LTR-10	5.3	1.9	5.5	6.2	4.5 mg/kg
LTR-11	24.6	3.0	8.4	23.4 µg/kg	N/A
LTR-12	88 µg/kg	49 µg/kg	6.5 µg/kg	38.6 µg/kg	N/A
LTR-13	12.4	3.7	16.8	16.5	52
LTR-14	8.4	27.8 µg/kg	22.2 µg/kg	38 µg/kg	12.6
LTR-15	6.3	3.8	10.6	5.7	10.9
LTR-16	6.6	6.2	10.9	5.2	27.5 mg/kg
LTR-17	13.8	8.8	13.8	7.2	N/A
LTR-18	23.4	3.0	25.5	1.3	N/A
LTR-19	47 µg/kg	22.7 µg/kg	24.2 µg/kg	15.5 µg/kg	N/A
Sample Location	0-2 cm (10/2015)	0-2 cm (1/2016)	0-10 cm (10/2015)	0-10 cm (1/2016)	0-60 cm (2016) µg/kg
LTR-20	15.5	5.3	61.3	7.9	N/A
LTR-21	13.5	8.7	13.5	63 µg/kg	12.8 µg/kg
LTR-22	14.3	3.7	8.9	10.8	N/A

iii. Other Response Actions

Cleanup work has occurred at adjacent areas to the EAA (Figure 1). The Boeing Company performed a RCRA Corrective Action of contaminated sediments, removing the sediments above 12 mg/kg OC from the adjacent Boeing Plant 2 in-water areas, and replacing them with clean backfill. This work was completed from 2013-early 2015. The area adjacent to the EAA (bordering along the north/west portion of the EAA), referred to as the "DSOA", began on October 8, 2014, shortly after the completion of some work performed by EMJ at the EAA. Coordination before, during and after has occurred with The Boeing Company regarding the activities at each of the respective cleanups to ensure that the removal activities at each site minimized the potential for adverse impacts to the surrounding cleanup projects.

Directly across from the EMJ EAA is the T-117 EAA (see Figure 1). The T-117 cleanup area includes upland and in-water portions. Contaminated in-water sediments above PCB concentration of 12 mg/kg OC were dredged and replaced with clean backfill. That work was performed through 2015.

The upland area just east of the “cofferdam” area within the EMJ EAA, referred to as the Jorgensen Forge Outfall Site, is the subject of a Time Critical Removal Action being performed by The Boeing Company and Jorgensen Forge Corporation. This work is being performed to address PCB contaminated soils associated with an outfall pipe that previously ran along the border of The Boeing Plant 2 and Jorgensen Forge Corporation facility properties. Approximately 90 cubic yards of contaminated soils were removed from this area in 2015. Additional work is expected to occur in the summer of 2017.

Future work is also planned for the upland Jorgensen Forge Corporation facility. In 2015, Washington State Department of Ecology (Ecology) issued a Model Toxics Cleanup Act (MTCA) enforcement order. Under the order, Jorgensen Forge Corporation is required to investigate and develop a cleanup action plan for the upland facility. In 2016, Jorgensen Forge Corporation declared bankruptcy. Ecology is currently working with the new owners to negotiate a new legal agreement and move forward with the investigation of the upland facility.

III. NATURE AND EXTENT OF CONTAMINATION

Several key documents and sources provide information of the nature and extent of contamination at the EAA for the conditions that existed prior to EMJ’s work in 2014. These include:

- Final EE/CA, Jorgensen Forge Facility (Anchor Environmental QEA, 2011)
- Final Source Control Evaluation Report, prepared for the Washington State Department of Ecology (Anchor Environmental QEA and Farallon, 2008)
- Data Gap Investigation Work Plan, prepared for the Washington State Department of Ecology (Anchor Environmental QEA and Farallon, 2008)
- Draft Source Control Evaluation Addendum Report, prepared for the Washington State Department of Ecology (Anchor Environmental QEA and Farallon, 2009)

Section II describes the sampling data collected associated with the performance of some removal activities during the summer of 2014. As described in that section: EMJ sampled the subsurface and surface sediments throughout the EAA in 2014 and 2016. This sampling effort identified PCBs that exceed the RvAL, set to protect benthic organisms from any adverse impacts, in the surface and subsurface sediments within the EAA. Of particular concern is the western portion of the EAA that abuts navigations channel, which appears to have no backfill material cover after some of the contaminated sediments were removed in the summer of 2014. This is because both the surface and subsurface samples apply when characterizing the leave surface in the area along the western boundary of the EAA where no backfill was placed, and some of these samples are significantly greater than the removal action level (1.3 times the RvAL to 105 times the RvAL).

In addition to existing risks posed by the surface sediments in exceedance the RvAL established to prevent adverse effects to benthic organisms (based on surface and sub-surface sampling data); the subsurface PCB contaminated sediments pose an additional risk of migrating through the interstitial spaces of the backfill material over time and breaking through to the surface sediments of the EAA. To assess these risks to human health and the environment posed by the breakthrough of subsurface PCB concentrations throughout the EAA, EPA tasked the Corps of Engineers to model the potential for PCBs to breakthrough into the upper 45 cm of backfill material in exceedance of the RvAL (12 mg/kg OC or 130 μg/kg dry weight).

The table below identifies the predicted minimum backfill thickness needed within each DMU to prevent the PCB concentration in the upper 45 cm of the sediment from exceeding the PCB RvAL (130 µg/kg dry weight) over 100 year timeframe. A more detailed table of the breakthrough analysis can be found in Figure 4 of this document.

Dredge Management Unit	**Minimum Backfill Thickness (inches)**	**Predicted PCB Concentration (µg/kg dry weight)**
DMU-1	24	79
DMU-2	24	6
DMU-3	60	58
DMU-4	60	63
DMU-5	130	119
Cofferdam	142	97

The 45 cm interval was used for assessing breakthrough because it is the compliance depth for Recovery Category 1 areas in the LDW Record of Decision (ROD). An analysis of the Remedial Investigation/Feasibility Study (RI/FS) maps used to designate recovery categories for the ROD indicates that the EAA would fall within Recovery Category 1. The 45 cm interval was also identified after considering the erosion and sedimentation predictions from the RI/FS work, as well as scour potential and hydrodynamics of the site.

A review of the draft Pre-Final Certification Inspection Report indicates that there are places within each of the DMUs at the EAA, except perhaps the "cofferdam" area, where backfill thickness is less than that which is necessary to prevent breakthrough of PCBs in to the upper sediments at the EAA. This presents a predicted risk of additional PCB contamination of the surface sediments with the already existing PCB contaminated surface sediments above the RvAL within the EAA.

As previously mentioned, the entire western edge of the EAA along the navigation channel has little to no backfill material, posing both an existing and predicted risk of exceeding the removal action level established to prevent adverse impacts to benthic organisms. More refined mapping of the as-built conditions showing the volume of backfill material throughout the EAA is needed to quantify the extent of this existing risk to human health and the environment.

IV. THREAT TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT

Currently, elevated concentrations of PCBs above the RvAL are found within the backfill surface and subsurface sediments at the EAA, including the dredge surface along the navigational channel where no backfill material was placed. Additionally, a breakthrough analysis of subsurface PCBs in exceedance of the RvAL (12 mg/kg OC) into the upper 45 cm of the EAA demonstrates potential risk to human health and the environment, as described in Section III of this Memorandum. PCBs are a "hazardous substances" as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14). Conditions present in the EAA constitute an actual or threatened release to the environment and meet the factors in the National Contingency Plan 40 C.F.R. § 300.415(b)(2), specifically (i) and (ii), for a removal action as follows.

A. Human Health and the Environment

Risks to Marine Benthic Invertebrates: The presence of elevated concentrations of PCBs within the surface and subsurface sediments at the EAA pose an existing threat to marine benthic invertebrates. The RvAL represents the level of no adverse effects for benthic invertebrates. The goal of the Sediment Management Standards upon which the RvAL is based is to "reduce and ultimately eliminate adverse effects on biological resources and threats to human health from surface sediment contamination." Benthic invertebrates are a major component of the food web within the LDW ecosystem. For example, benthic invertebrates in estuarine systems are prey species for young salmonids before they out-migrate to the marine environment[1]. The LDW has several salmonid species, including several listed on the Endangered Species list. Protecting the benthic community within the LDW is important not only for the impacted benthic community, but also to the overall ecological health of the riverine system. Therefore, the current EAA conditions pose an existing threat of actual exposure to animals, sensitive ecosystems and the food chain from PCBs.

Risks to Human Health: The LDW ROD is established to "*reduce risks associated with the consumption of contaminated resident LDW fish and shellfish by adults and children with the highest potential exposure to protect human health.*" The ROD establishes cleanup levels for sediments PCBs that will reduce the bioavailability of PCBs, and, in turn, reducing the contaminant concentration in fish tissue that fish consumers would be exposed to. The PCB cleanup level to address this exposure pathway is 2 μg/kg dry weight. This cleanup level is based on background concentrations because a risk-based cleanup level to protect fish consumers is below background. PCBs have been detected in the surface sediment (0-2 cm; 0-10 cm) above this value throughout the EAA. The breakthrough analysis of subsurface sediments with PCBs also predict that the cleanup level will be exceeded over time as the subsurface PCBs migrate upwards in to the upper 45 cm of the EAA. The 2016 Fishers Study also found that that people continue to consumer resident fish and shellfish at the LDW despite a "do not eat" advisory for these species. Therefore, the current EAA conditions pose an existing threat of actual exposure to nearby human populations in consuming PCB contaminated seafood.

Risks to Ecological/Wildlife: The LDW ROD also intends to "*reduce to protective levels risks to crabs, fish, birds, and mammals from exposure to contaminated sediment, surface water, and prey*." The risks to these wildlife will be reduced by reducing sediment and surface water PCB concentrations or bioavailability, which will reduce PCB concentrations in tissue. The cleanup level established for this exposure pathway is 128 μg/kg dry weight within the upper 0-10 cm. PCB contaminated sediments above this level exist in surface sediments in the EAA. Additionally, the breakthrough analysis predicts a risk that the sub-surface PCB concentrations will exceed this value in to the upper sediments over time and pose additional threats to wildlife. Therefore, the current EAA conditions pose an existing threat to actual exposure by animals, the food chain and sensitive ecosystems from PCBs.

B. Expected Change If No Action Is Taken

If no action is taken, or if this action is delayed:

- hazardous substances will remain as a threat to human health and the environment based on fish consumption pathway, and a threat to benthic invertebrates within the contaminated sediments; and

- PCBs in the sub-surface and surface sediments will remain an ongoing source of contaminants to the EAA and LDW. These PCBs, over time, may contribute to or exacerbate bioaccumulation of PCBs in fish tissue. Sub-surface PCB contamination is predicted to migrate through the existing backfill material over time, adding to the overall PCB concentrations in the surface of the sediments throughout the EAA. This will likely magnify the potential adverse impacts to human health, benthic invertebrates and wildlife throughout the EAA if no action is taken.

[1] Quinn, T. 2005. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press.

V. ENFORCEMENT ACTIONS

The EPA obtained stipulated penalties from EMJ in the amount of $216,500 in 2016 for deviating from the EPA approved plans under the Settlement Agreement.

Pending an anticipated agreement with EMJ, the EPA plans to amend the existing Settlement Agreement and associated Statement of Work to include performance of a supplemental EE/CA by EMJ to address the ongoing risks posed by PCBs in the sediments at the EAA. Based on the supplemental EE/CA and other information, the EPA will determine whether there is a basis for amending the AM in order to address the risks at the EAA.

VI. PROPOSED PROJECT AND COSTS AND PUBLIC PARTICIPATION

Because a planning period of at least six months exists before on-site activities must be initiated, a non-time-critical removal action is appropriate. A supplemental EE/CA Addendum will be prepared to define the scope and the approach for the non-time-critical removal action to address ongoing risks associated with the EAA. Information on nature and extent of contamination from existing data will be used to support the supplemental EE/CA. Information developed as part of the 2011 EE/CA identified a limited number of removal action approaches and these will be refined and evaluated in the supplemental EE/CA. The likely technology and process options that will be subject to detailed analysis include: (1) full removal of the contaminated PCB sediments above the RvAL at the EAA and placement of clean backfill material; (2) placement of a cap and long-term ICs needed to address ongoing risks at the EAA; and (3) a combination of removal of contaminated PCB sediments above the RvAL at the EAA with capping and long-term ICs.

A final removal alternative identified in the supplemental EE/CA will be selected following public comment and evaluation. It is anticipated that costs for conducting the supplemental EE/CA will be paid for by EMJ.

VII. RECOMMENDATION

Based on the available data, conditions at the EAA within LDW Superfund Site meet the criteria in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300.415, for a non-time-critical removal action. Therefore, I recommend your approval to conduct a supplemental EE/CA.

Approval: __________ Disapproval: __________

Signature: ____

Date: ____

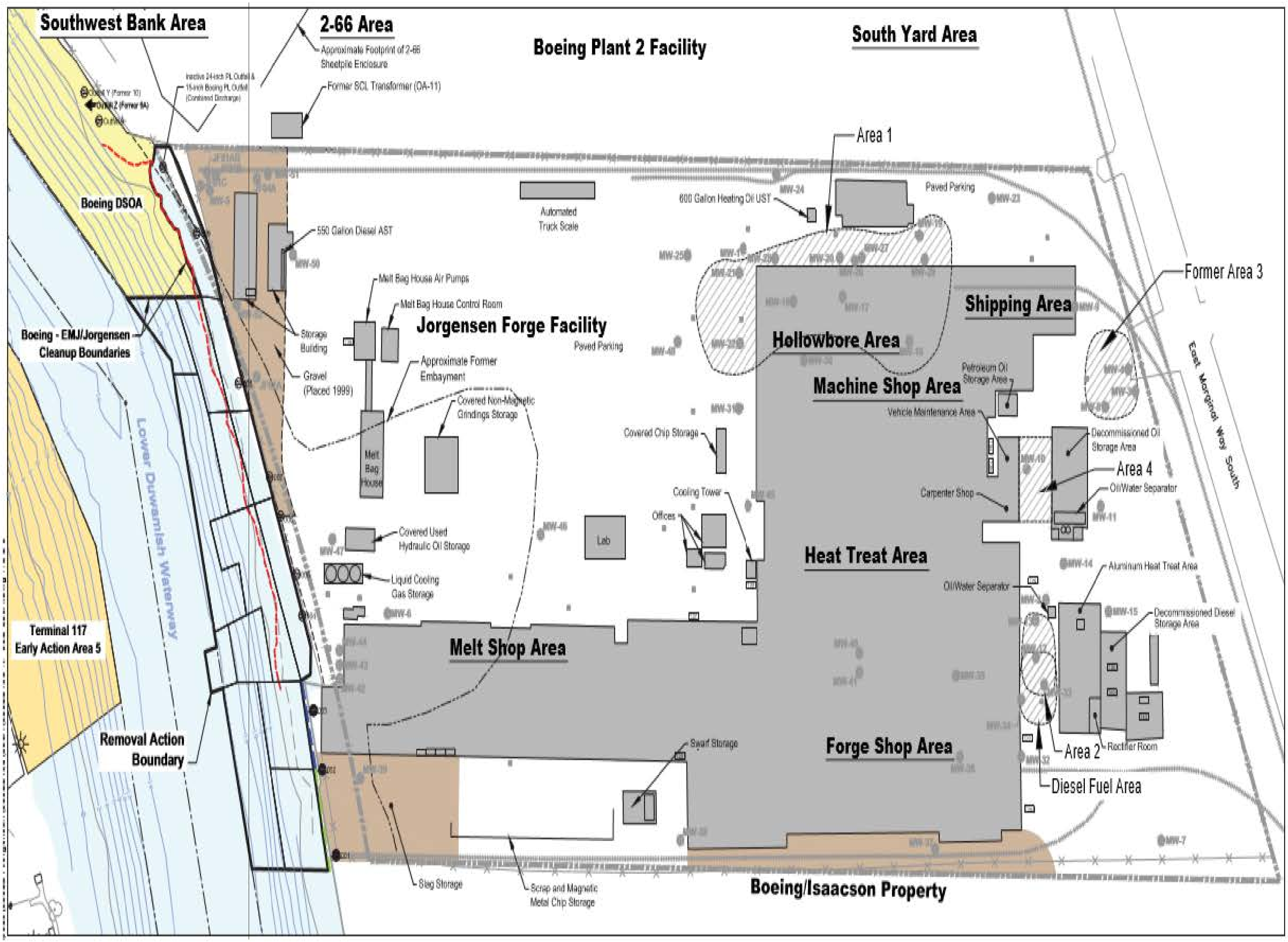
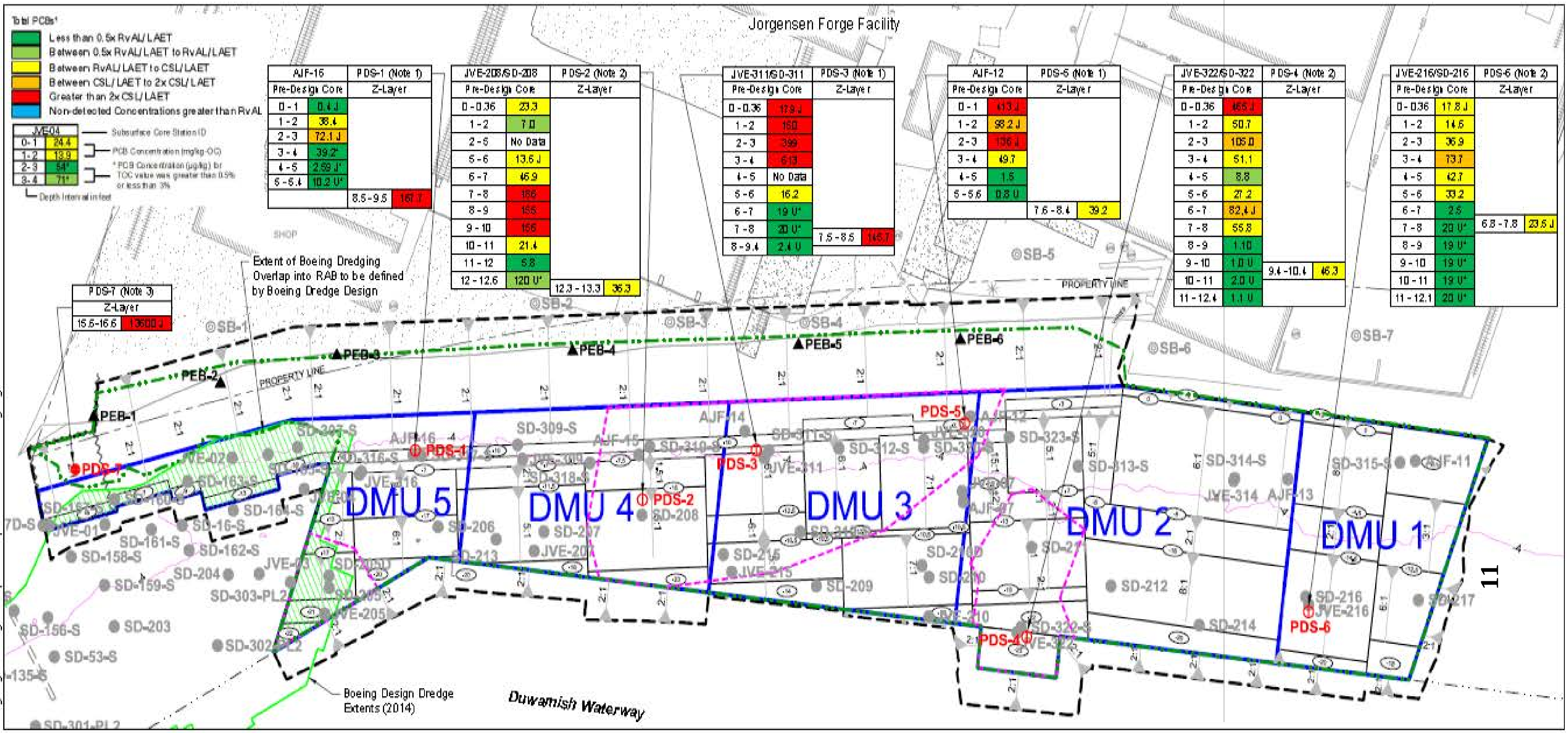


Figure 1 Site Location

Figure 2 EMJ 2014 Z-Layer PCB Concentrations



HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

NOTES:

1. Sediment z-layer locations PDS-1, PDS-3 and PDS-5 contain 5.4 feet, 6.4 feet and 6.3 feet, respectively, of overlying clean material that contains 0.5 percent by weight granular activated carbon (GAC).
2. Sediment z-layer locations PDS-2, PDS-4 and PDS-6 contain 9.4 feet, 1.9 feet and 8.4 feet, respectively, of overlying clean backfill material.
3. Sediment z-layer location PDS-7 was collected within the in-water containment barrier constructed around sediments impacted by the Jorgensen Forge Outfall Site. This location is overlain by 17.5 feet of clean shoreline containment material that contains 0.5 percent GAC.
4. Removal Action Level (RvAL) = 12 mg/kg-OC.
5. Lower Apparent Effects Threshold (LAET) = 0.13 mg/kg.
6. Cleanup Screening Level (CSL) = 65 mg/kg-OC.
7. Second Lower Apparent Effects Threshold (2LAET) = 1 mg/kg.

LEGEND:

Navigation Channel

U = Compound analyzed, but not detected above detection limit.

J = Estimated value.

UJ = Compound analyzed, but not detected above estimated detection limit.

OC = Organic carbon.

Required Dredge Elevation (ft MLLW)
Top of Side Slope
Final Grade
Dredge Boundary
Dredge Excavation Boundary
Removal Action Boundary
-4 ft MLLW Elevation Contour
SB-1 Existing Soil Boring Sample
SD-207 Existing Subsurface Sediment Sample

Jorgensen Forge Outfall Site Containment Barrier Wall
Dredge Management Unit (DMU)
Relatively Elevated Total PCB Concentration Area
PDS-1 Actual Sediment Z-Layer Confirmation Sample
PEB-6 Actual Shoreline Bank Z-Layer Confirmation Sample
PDS-7 Actual Jorgensen Forge Outfall Site Shoreline Bank Z-Layer Confirmation Sample

0 50
Scale in Feet

ANCHOR QEA

Figure 1
Summary of Pre-design and Z-layer Sampling Concentrations
Jorgensen Forge Early Action Area

Figure 3 EMJ Surface Sampling Locations

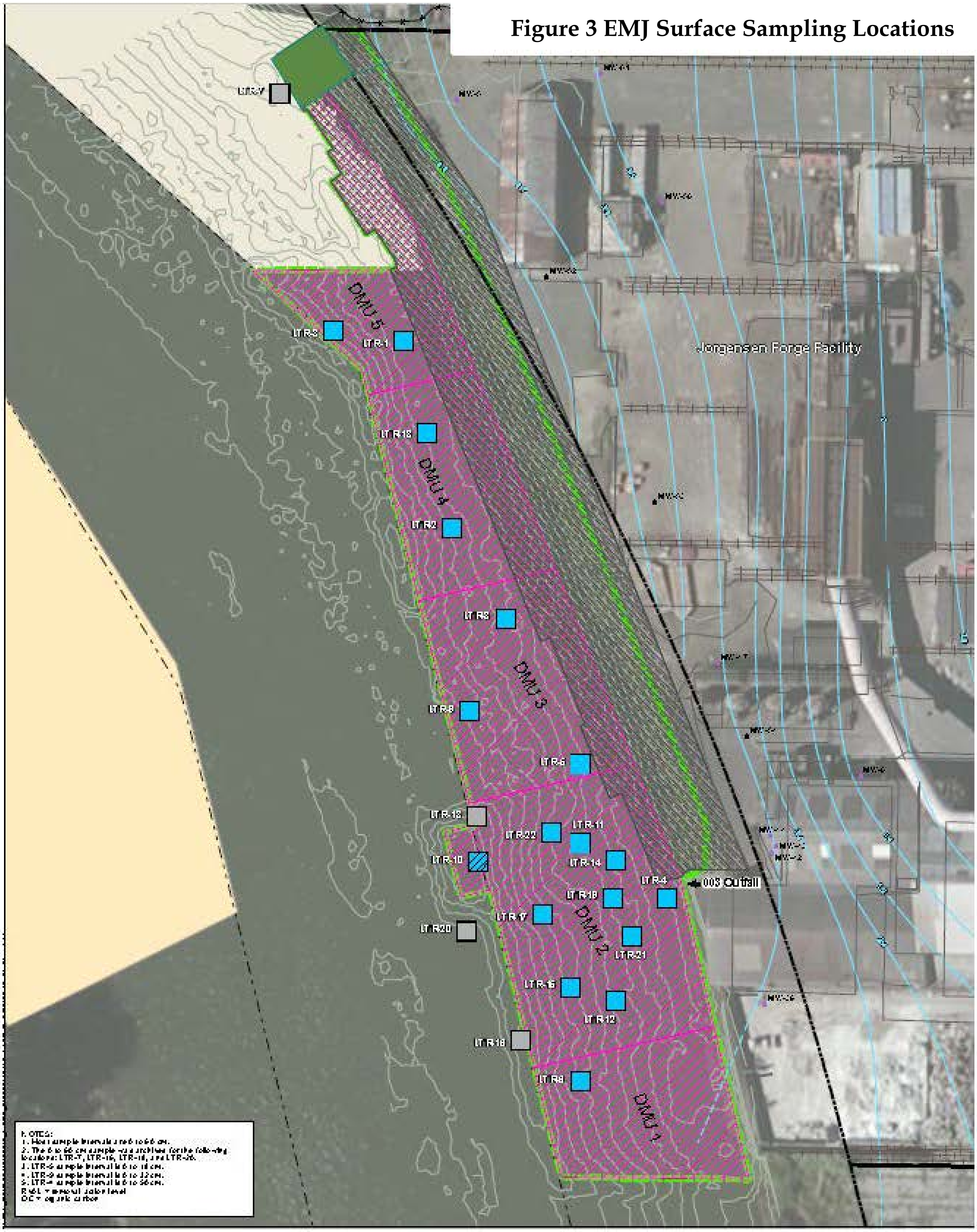


Figure 4 Breakthrough Analysis into surface of backfill over 100 year post

Table 2. Predicted Total PCB Concentrations 100 years Post Construction for Backfill Thickness Sensitivity Analysis

	PDS-1 (2014)					PDS-2 (2014)				
DMU	DMU 5					DMU 4				
Total Organic Carbon (%) in Backfill (0-60cm)	0.031					0.062				
Total Organic Carbon (%) in Z-layer (0-1ft)	0.93					0.694				
Concentration Measured in Z-Layer (0-1ft)	1560					252				
Sensitivity Analysis of Backfill Thickness (cm)	30	60	90	120	330	30	60	90	120	150
Approx. depth from surface of backfill (cm)	Modeled Non-Steady State Backfill Concentration at 100 Years Post Construction (ug/kg dw)									
0	1560	1560	1551	1471	74	252	237	155	68	23
4	1560	1560	1553			252	241	170		
8	1560	1560	1555	1492		252	246	184	84	32
11	1560	1560		1509		252	247		101	
15	1560	1560	1557		114	252	249	196		44
19	1560	1560	1558	1522		252	250	207	119	
23	1560	1560	1558	1532		252	251	217	138	59
27	1560	1560	1559			252	251	225		
30	1560	1560	1559	1540		252	252	232	156	76
34	native sediment	1560	1560	1546	169	native sediment	252	237	173	
38		1560					252			95
42		1560	1560	1550			252	242	189	
46		1560	1560	1554			252	245	203	115
Average concentration over 45cm interval	**1560**	**1560**	**1557**	**1524**	**119**	**252**	**248**	**210**	**137**	**63**

	PDS-3 (2014)					PDS-4 (2014)			
DMU	DMU 3					DMU 2			
Total Organic Carbon (%) in Backfill (0-60cm)	0.092					1.12			
Total Organic Carbon (%) in Z-layer (0-1ft)	0.659					1.64			
Concentration Measured in Z-Layer (0-1ft)	960					760			
Sensitivity Analysis of Backfill Thickness (cm)	30	60	90	120	150	30	60	90	120
Approx. depth from surface of backfill (cm)	Modeled Non-Steady State Backfill Concentration at 100 Years Post Construction (ug/kg dw)								
0	954	604	164	28	4	0	0	0	0
4	958	659	215			0	0	0	
8	959	756	274	45	8	0	0	0	0
11	960	797		70		1	0		0
15	960	832	339		15	11	0	0	
19	960	862	410	105		113	0	0	0
23	960	906	483	150	27	423	0	0	0
27	960	922	557			646	0	0	
30	960	933	628	207	46	760	0	0	0
34	native sediment	942	695	275		native sediment	0	0	0
38		953			74		4		
42		956	754	352			16	0	0
46		957	805	436	116		53	0	0
Average concentration over 45cm interval	**959**	**852**	**484**	**185**	**41**	**384**	**6**	**0**	**0**

	PDS-5 (2016)					PDS-6 (2014)				PDS-7 (2016)				
DMU	DMU 3					DMU 1				coffer dam				
Total Organic Carbon (%) in Backfill (0-60cm)	0.104					0.202				0.031				
Total Organic Carbon (%) in Z-layer (0-1ft)	0.818					0.841				0.05				
Concentration Measured in Z-Layer (0-1ft)	2830					198				2200				
Sensitivity Analysis of Backfill Thickness (cm)	30	60	90	120	150	30	60	90	120	30	60	90	120	360
Approx. depth from surface of backfill (cm)	Modeled Non-Steady State Backfill Concentration at 100 Years Post Construction (ug/kg dw)													
0	2777	1357	254	30	3	103	3	0	0	2200	2200	2187	2074	55
4	2809	1543	360			139	5	0		2200	2200	2191		
8	2822	1901	493	55	7	167	14	0	0	2200	2200	2193	2104	
11	2826	2064		94		180	21		0	2200	2200		2128	
15	2828	2212	655		15	189	30	1		2200	2200	2195		
19	2830	2343	843	155		195	42	1	0	2200	2200	2197	2147	91
23	2830	2549	1053	243	30	197	73	3	0	2200	2200	2198	2161	
27	2830	2625	1279			198	91	5		2200	2200	2198		
30	2830	2684	1512	365	59	198	110	10	0	2200	2200	2199	2172	
34	native sediment	2730	1741	525		native sediment	128	17	1	native sediment	2200	2199	2180	144
38		2787			107		159				2200			
42		2804	1959	724			172	28	1		2200	2200	2187	
46		2814	2157	957	184		181	43	3		2200	2200	2191	
Average concentration over 45cm interval	**2823**	**2340**	**1119**	**350**	**58**	**181**	**79**	**10**	**1**	**2200**	**2200**	**2196**	**2149**	**97**

Indicates exceedence of the Jorgensen RvAL (12 mg/kg OC; 130 ug/kg dw)